

METHODOLOGY OF RESEARCH INTO THE DYNAMIC FORMATION OF PROFESSIONALLY IMPORTANT COGNITIVE AND PERSONAL QUALITIES OF IT SPECIALTIES STUDENTS

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Abstract: *The article is devoted to the description of certain methods which identify the dynamic formation of the structure of intelligence and the identity of the IT training profile students. The study uses a technique that includes the colour-associative test of M. Luscher, the definition of the Myers-Briggs typology, and a modified intelligence structure test for R. Amthauer. The verification of the effectiveness of the methodology was carried out by testing students of the Faculty of Information Technologies of the Borys Grinchenko Kyiv University, the results of which are demonstrated on the basis of the obtained data. The proposed methodology allowed to reveal the peculiarities of the impact of studying at the university on the professionally important qualities of future IT industry professionals.*

Keywords: intelligence structure, IT specialists, cognitive qualities, research methodology, verbal and nonverbal intelligence.

INTRODUCTION

Changing the priorities and requirements for the quality of education and training of future workers as a result of the "movement" of the labour market into the intellectual sphere of human activity that requires new approaches to education, where not only formal but also informal and informational education can raise basic human competencies (Morze, Spivak, 2014), first of all, the ability to use electronic teaching aids in a synthetic learning environment and social networks (Lytvynova, Burov, 2017) consider the problems of cybersecurity occurring before a person and immersed in the digital world (Burov, 2016).

The need for reforming education in the direction of individualizing the trajectory and personalizing learning tools has become a global challenge of time (Morze et al., 2014). Changing the priorities of mankind from the production of material and real objects of life to the production of new knowledge and metadata, to the creation of the Internet things is accompanied by the disappearance of many professions and the emergence of new ones, based on the use of information and communication technologies (ICTs). Experts estimate that the main professions that have the highest demand in the international market today (Sharonov, 2017), and the requirements for the competences of future professionals in leading professions, focus not on the skills of specific skills, but on the social and cognitive capabilities of workers, personal skills related to solving problems, critical thinking, creativity, ability to manage an international team (Education and Training 2020 Work program).

The popularity of professions based on the design and intensive use of ICTs has exceeded all other professions over time. However, practice indicates that the shortage of IT specialists will be felt for a long time not so much because of the lack of appropriate educational institutions, but due to the lack of consideration of human abilities for these professions, which manifests itself in a particular feature of the structure of intelligence and, more broadly, the structure of the personality of IT professionals.

The purpose of this article is to develop and test the effectiveness of the method of identifying the peculiarities of the dynamics of the formation of the structure of intelligence and the identity of students of the IT training profile.

1. PROFESSIONALLY IMPORTANT QUALITIES OF IT PROFESSIONALS

It should be noted that intellect is not a static structure but one that is dynamically changing (Ushakov, 2004) not only during school years (Chalikova, 2002; Burov et al., 2012), but also during studies at university (Bodryakov et al., 2009).

At the same time, it is generally acknowledged that the world market needs labour equipped with new competences (Education and Training), which are formed on the basis of all components of intelligence (Burov et al., 2012). Special meaning this trend is due to the increasing role of technology of the Third Platform, including Internet of Things (IoT), robots and drones, complemented and virtual reality (AR / VR), 3D printers (Computer Review, 2018). In particular, in 2017 the AR/VR start dynamically develop the technological market, cognitive systems and artificial intelligence, and robotics.

Accordingly, there is a growing need for highly skilled IT workers, requirements for their professional skills and standards for the required competences are developed.

However, there is practically no clear understanding of professionally important qualities of specialists in this field and their peculiarities. And if theoretical and experimental features of the structure of the intellect of mathematicians and its formation in the profile classes of high school (Burov, 2018) are investigated theoretically and experimentally, then, in relation to the intellectual and personality characteristics of the development of senior IT students, there is an obvious lack of psychological and pedagogical research. Despite numerous publications on the psychology of programming, the fundamental work can be considered a book B. Schneidermann, but a number of questions raised in her there is still no substantiated answer (Schneiderman, 1984), in particular regarding the problem, whether there is a purely professional feature of the intelligence (its structure) and personality programmers and what they can do (Rozhnikov, 2014).

Psychological research on this issue mostly relates to the 70-80s of the last century, when the nature and trends of the programmer's work differed from today's. Attempts to identify the structural features of the intelligence of IT specialists are usually limited to studies of the psychology of experienced programmers and do not study the specific features of senior students who study in educational institutions (classes) of the IT profile whose personal and intellectual qualities are formed in a real digital environment, and not only under the influence of learning as such.

The generalization of information on professionally important intellectual and personal qualities of IT specialists allows one to distinguish the following: analytical abilities, logical and mathematical thinking, developed memory and imagination, patience, and propensity for intellectual activity (Doyle, 2018).

2. TECHNIQUE TO STUDY IT STUDENTS' INTELLECT AND PERSONALITY CHANGES

2.1. Research technique

The research used a methodology (Burov et al., 2012) which includes the tests:

- *M. Luscher color and associative test* (method of dual elections); purpose of use - assessment of stress, balance of psychological qualities; recorded parameters: total deviation (CO), Shiposha coefficient (VC), stress level (C), working capacity (RP), heteronomy-autonomy (GA), concentricity-eccentricity (KE), balance of personality traits (BL), the balance of the vegetative system (BV);
- *Definition of Myers-Briggs Typology* (MBTI); the purpose of use - an assessment of the ability to certain activities and individual properties of communication; Traditional indexes of an individual typology estimation according to the Myers-Briggs methodology are recorded based on the evaluation of the prevailing signs on the 4 criterion scales: extraversion E - introversion I (orientation of consciousness), intuition N - sensory S (way of orientation in a situation), thought / judgment J - perception P (method of preparation of decisions), thinking T - experience F (decision-making);
- *Modified Intellectual Structure Test for R. Amthauer* (TCI); purpose of application - definition of the level of development and structural features of intelligence, as well as attention, memory; The following subtests are used (the brackets show the corresponding structural component of the intelligence): LS (testing of language, ability to formulate judgments), GE (conceptual intuitive thinking), AN (combinatorial abilities, mobility and ability to switch thinking), RA (ability to solve practical computational problems character), ZR (logical and mathematical thinking), FS (figurative synthesis), WU (spatial thinking), ME (memory, attention). The values of the structural components of intelligence were calculated as the sum of the correct answers for each subtest, the values of verbal (VI) and nonverbal (NI) intelligence - as sum of values, respectively, LS, GE, AN, ME and RA, ZR, FS, WU. The overall IQ score was calculated as the sum of values VI and NI with a correction factor of 1.462.

The resulting primary data was entered into a spreadsheet for further analysis. Test results were not personified, but were taken into account for each course separately.

2.2. Subjects

In order to verify the effectiveness of the methodology, 65 students of 1-6 courses at Borys Grinchenko Kyiv University (University of Grinchenko) were involved in the testing, of which 51 represented the Faculty of Information Technologies.

All of the students took part in the testing as an element of the learning process. It should be noted that the 5th course was presented by only 2 students, who, moreover, showed low motivation to perform tests (first of all, subtitles of intelligence from the 4th, mathematical calculations, on the 8th, test of memory and attention) In addition, the indicator of the vegetative balance of the WB in them pointed to the mobilization of all functions and readiness for active

protection, escape from the procedure. Therefore, their results can be considered conditional.

2.3. Results and discussion

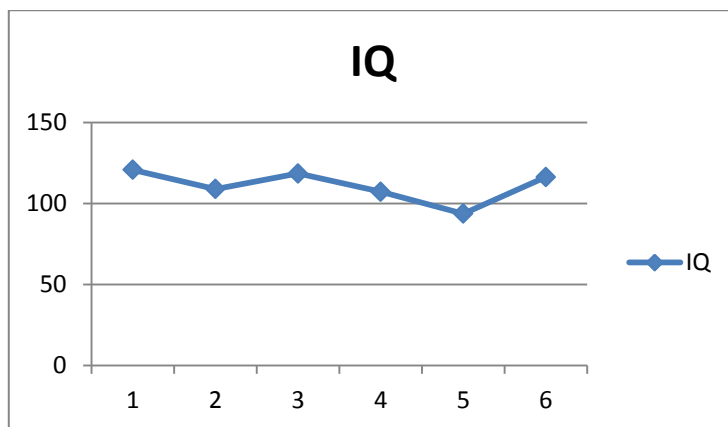


Figure. 1. Average value of general intelligence of students 1-6 courses

Source: Own work

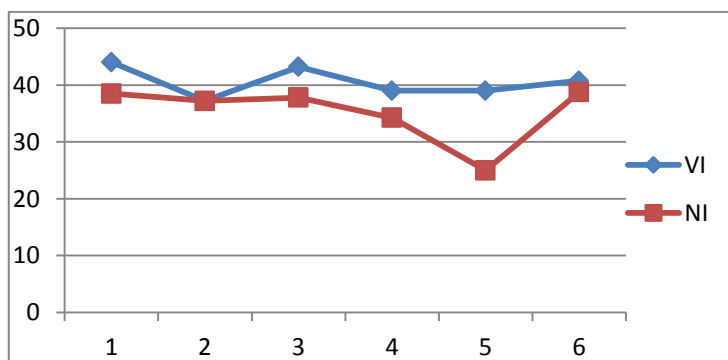


Figure 2. The mean value of the verbal (VI) and non-verbal (NI) intelligence of 1-6 year students. *Source: Own work*

Based on the data obtained, it is evident that the average level of students' intelligence is practically the same in all courses and is within the range of 110-120 points (Fig. 1). However, the comparison of verbal and nonverbal intelligence points to an unexpected tendency: in all the courses, nonverbal intelligence is lower than verbal (Fig. 2). For comparison: according to our preliminary data for assessing the level of intelligence of the 9th grade students of the profile IT lyceum, the average value of the IQ of the lyceum was 139, that is, it was significantly higher, and the nonverbal intelligence significantly differed from the average data in the schools of Ukraine towards the increase (approximately by 20%).

Higher indexes of verbal intelligence for students of all courses at the University of Grinchenko contrasted with the results of the students' survey of the IT-lyceum, but confirm the long-standing (1972) opinion of A.P. Ershov, who denied the priority of mathematical abilities in programmers. Experimentally, this idea was confirmed later (Orel, 2007), when it was shown that the work of programmers is dominated by verbal abilities, erudition and logical thinking, and also important thinking is imaginative. In our opinion, the contradictions between the results of students and students of the IT-lyceum can be explained by the current situation in Ukraine, when the motivation to study at an older school with a focus on mathematics is much lower than that of the IT specialty. Therefore, students with high mathematical abilities are oriented precisely to the IT training profile, where it will be easier to realize oneself in further work.

Comparison of the indicators of LS logical choice, RA mathematical thinking, ZR logical thinking, and figurative synthesis of FS confirms the above results, namely: higher level of development of logical thinking and figurative synthesis in comparison with mathematical thinking (Fig. 3).

Students' personal characteristics were analysed in accordance with the views of K. Jung and Myers-Briggs, namely on each of the binary criteria scales: the way of orientation in the situation NS, the way of preparing decisions JP, orientation of consciousness EI, decision-making TF (R3, respectively, a, b, c, d). The results are given in the points received by the students (on average on the course).

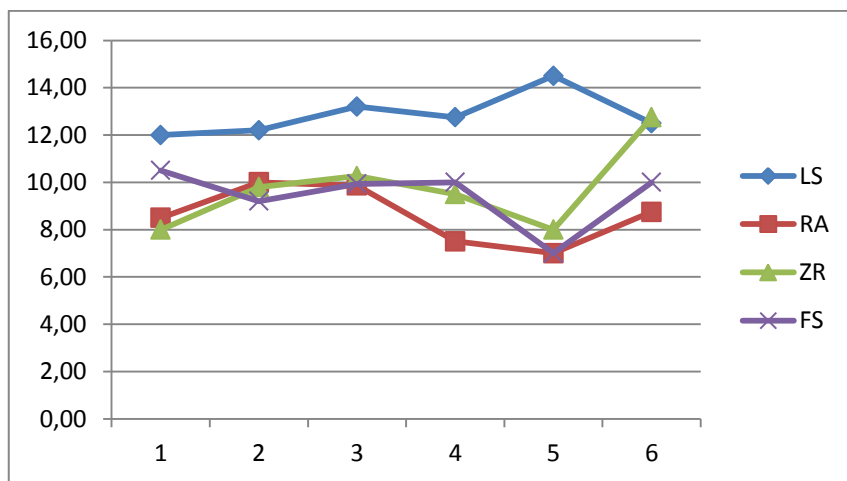
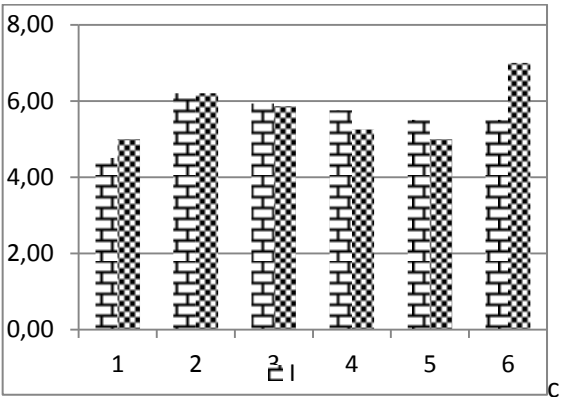
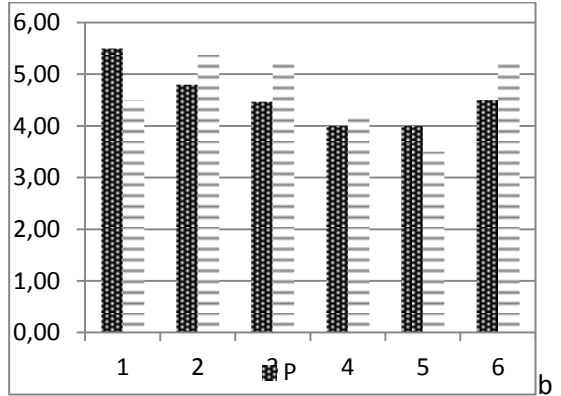
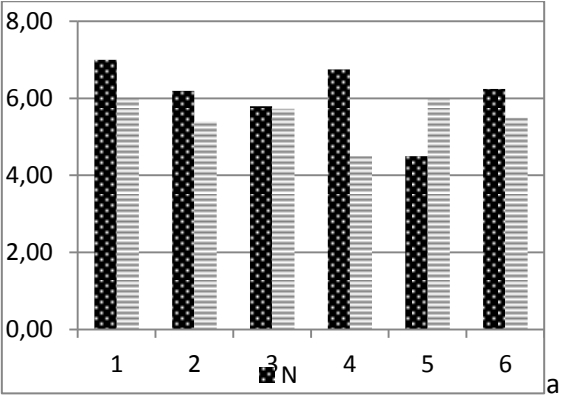


Figure 3. The level of development of individual components of the structure of intelligence. *Source: Own work*



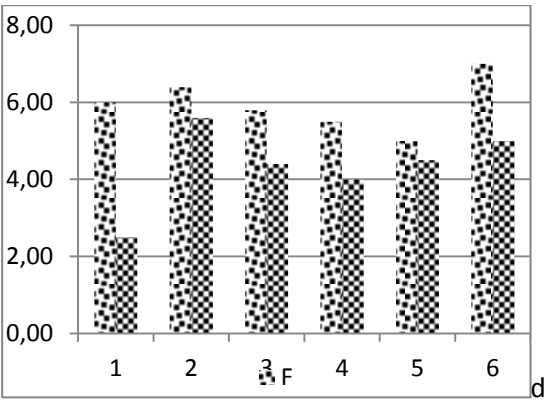


Figure 4. Manifestation of personality properties of students on criterion scales (designation see in the text) on the courses of study (abscissa axis)

Source: Own work

From the above data, it follows that the intuition of IT students is more typical than the sensor, which could be expected, taking into account the requirements of the future profession. The data of 5-course students somewhat "fall out" from the general trend, but the unreliability of their assessments we drew attention higher.

According to the criterial scale of the method of decision-making, judgment J dominates in comparison with perception P practically in all courses, except for the first one. This is logical, because the freshmen, as a rule, are young people who are just starting out of the teenage age, being guided more often by irrational criteria than rational ones.

The same reason can be explained by the predominant nature of extraversion E in freshmen. According to previous studies, in extracurricular subjects of the examined schools, extroversion is significantly dominated by introversion regardless of the school profile (Burov et al., 2012). The manifestation of the prevalence of extraversion in the 6th year students may be due to the peculiarities of the selection of masters who must not only have the necessary professional skills but also the ability to work in a team, to communicate with colleagues and users. With regard to students from the 2nd to the 4th year, the prevalence of introversion may be explained by the selection of training for individuals focused on a greater focus on the inner world and behaviour patterns.

The predominance of F's feeling of thinking T for students of all courses in the decision-making scale confirms the views of the part of psychologists who believe that for programmers, not only formal logical thinking is important, but also a

sense of the image of verbal structures that are ICTs. However, this question requires a more in-depth study.

Analysis of the indicators of the balance of psychological qualities of students of IT direction (Table 1) allowed to trace the dynamics of changes in these qualities during the study at the university.

Table 1.

Students' psychological qualities balance

Course	Г-А	К-Е	БЛ	ББ
1	1,95	0,65	1,35	2,45
2	-1,28	2,68	0,96	-0,86
3	-0,53	1,88	0,48	-0,03
4	-1,41	-0,46	0,61	0,79
5				
6	-0,30	1,75	-0,25	-0,93

Source: Own work

On the scale of heteronomy (0 ... 9.8) -autonomy (0 ... -9.8), according to which, according to M. Luscher, autonomy reflects self-determination, arbitrariness, independence, and heteronomy - complacency, compromise, obedience, avoidance. It should be noted that first-year students again differ from students of further courses in the tendency to heteronomy. However, this may be more a manifestation of the psychology of the first-year student in general than the professionally defined specifics. In the future, obviously, autonomy with a tendency to approach to "0", that is, a greater balance.

On the scale of concentricity-eccentricity K-E, students of all courses, except for the 4th, showed some tendency to concentricity, that is, orientation to their own needs and problems.

The personal balance of the BL indicates the apparent tendency of transition from an unstable and contradictory personality to the first year to a moderate balance of personal qualities during the studies at the university.

In our opinion, the scale of the vegetative balance of the WB reflects the effect of the student's impact on the student rather than professional development, since for students of the 1st and 4th courses are characterized by mobilization of all functions and preparation for active protection. At the same time, students in the

2nd, 3rd, and 6th courses have shown a tendency towards being oriented toward rest, recovery and resource conservation.

In general, it must be admitted that the dynamics and level of student balance sheet characteristics reflect not so much the professional formation of IT specialists, but how relevant is the dynamics of study at the university.

CONCLUSION

The proposed method which identifies the dynamic formation of the structure of intelligence and the identity of the IT training profile student allowed to reveal the peculiarities of the impact of studying at the university on the indicated professionally important qualities.

It has been established that the average level of students' intelligence is practically the same in all courses and is within the range of 110-120 points. Higher verbal intelligence rates for students of all courses at the University of Grinchenko are in contrast with the results of the survey of IT students, but confirm the results of other studies on the psychology of programmers, which have shown that programmers are dominated by verbal abilities and logical thinking, as well as imaginative thinking. In our study of the comparison of indicators of logical choice of LS, RA mathematical thinking, logical thinking ZR and figurative synthesis of FS confirmed students a higher level of development of logical thinking and figurative synthesis compared with mathematical thinking.

In our personality structure, our study found that intuition for IT students is more characteristic than a sensor; according to the scale of the decision-making method, judgments J prevail in comparison with perception P practically in all courses, except for the first; On the introversion-extraversion scale, the students of the first and the sixth years are dominated by extroverts, while in other courses - introverts; on the decision-making scale for students of all courses, the feeling of F prevails over the thinking of T.

The dynamics and level of students' balance sheet indicators reflects not so much the professional formation of IT specialists, but how relevant is the dynamics of study at the university.

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